IBACOS

Home to Innovation

Building AMERICA

Vision

Founded in 1991, the vision of IBACOS is to catalyze the construction of measurably better homes, and to affect rapid adoption of new technology in the marketplace.

This vision is pursued through the research and development of both technical and market processes.

Alliance

Manufacturers

Builders

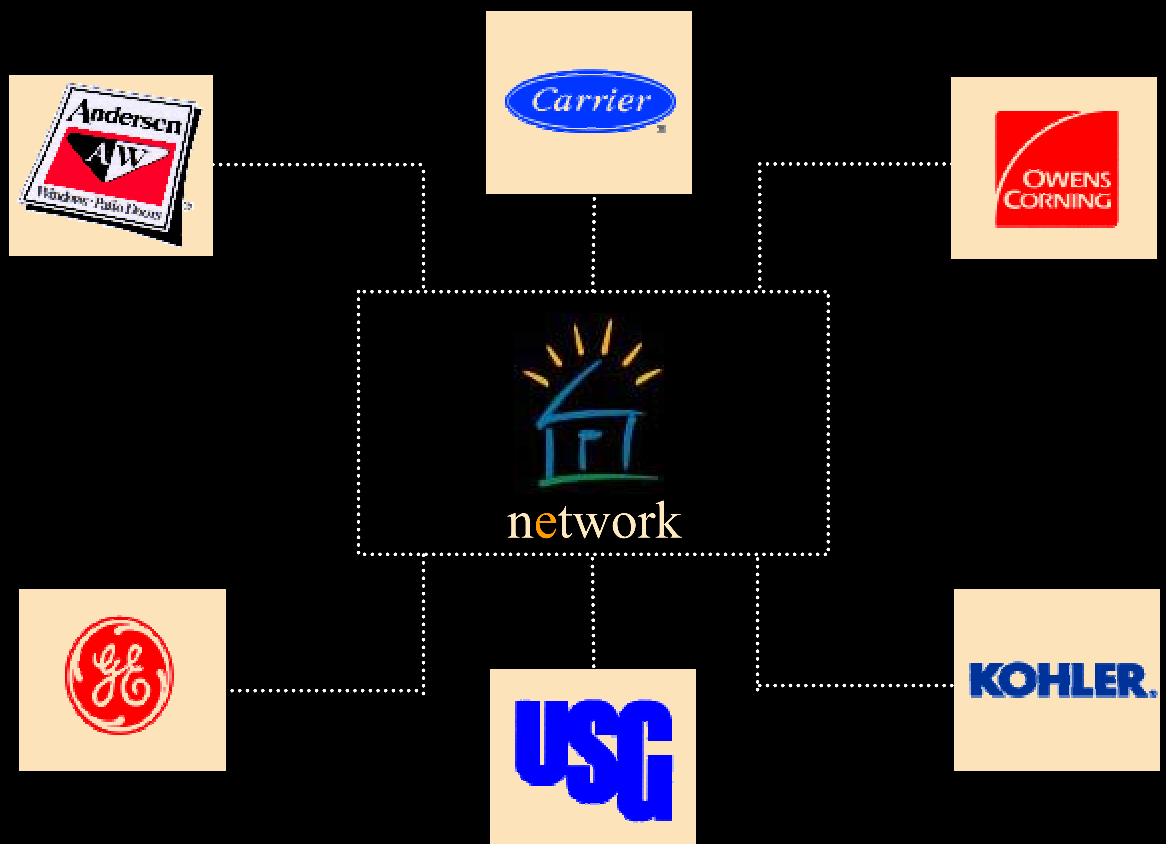
IBACOS

Home Innovation Network

Government

Experts

Manufacturer Partners



Builder Partners

Roger Glunt, Inc.
PA

Montgomery Rust
PA

Ralph Falbo, Inc.
PA

Farm Development
NY

A. Richard Kacin
PA

Heartland Homes
PA

Pennrose Properties
PA

Estridge
IN

Fortis
NC

John Wieland
GA

Hedgewood
GA

Venture Homes
GA

Classic Homes
CO

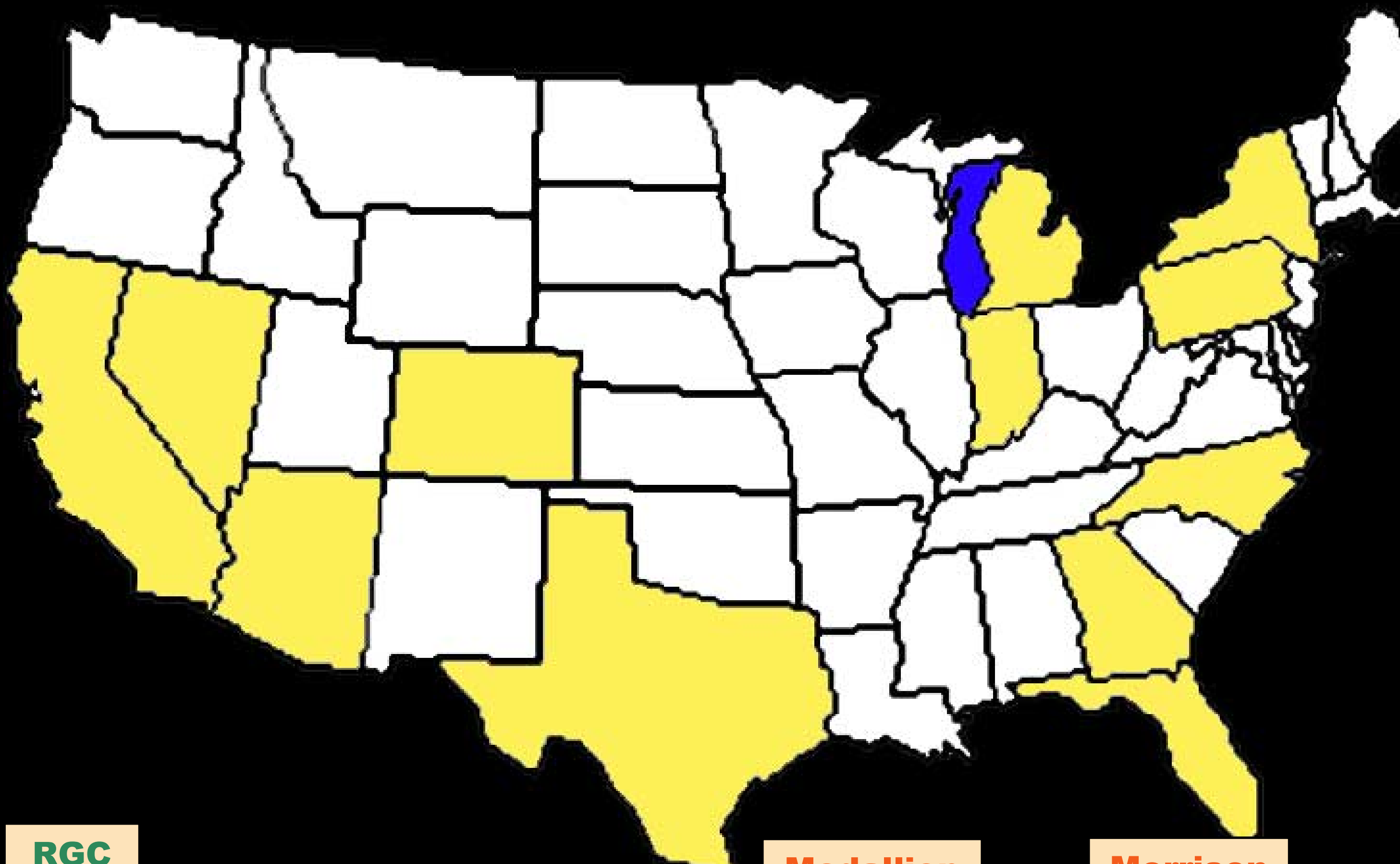
Pulte
NV/MI

RGC
CA

Shea
CA

Watt Laing
CA

RGC
AZ



Medallion
TX

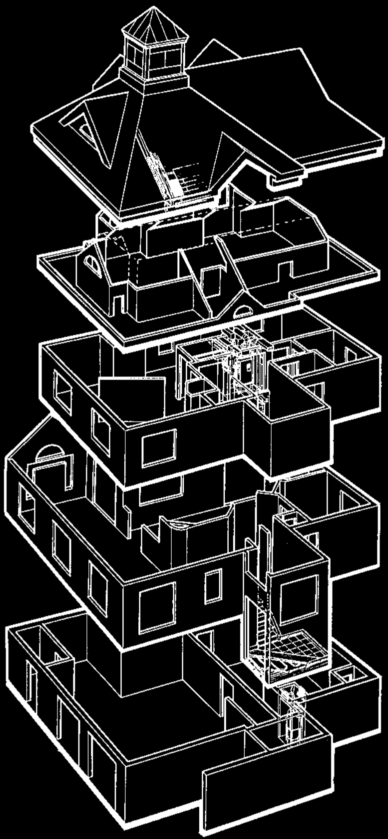
Morrison
FL

IBACOS Builder Programs

- An opportunity to advance the Building America energy efficiency & durability goals to a major builder with an eye to implementing them on a widespread basis.
- An opportunity to learn about and optimize home construction and performance in a variety of different climate regions.
- An opportunity to create builder partnerships that result in technology transfer through training and other collaborative efforts.
- General approach is to build a series of prototype homes, complete with training and technical support, at a technological and learning pace that the builder can benefit from and handle.

Basic System Research

- Design Integration
- Shell
- HCVI
- PSC
- Finishes
- Kitchen
- Bath
- Quality



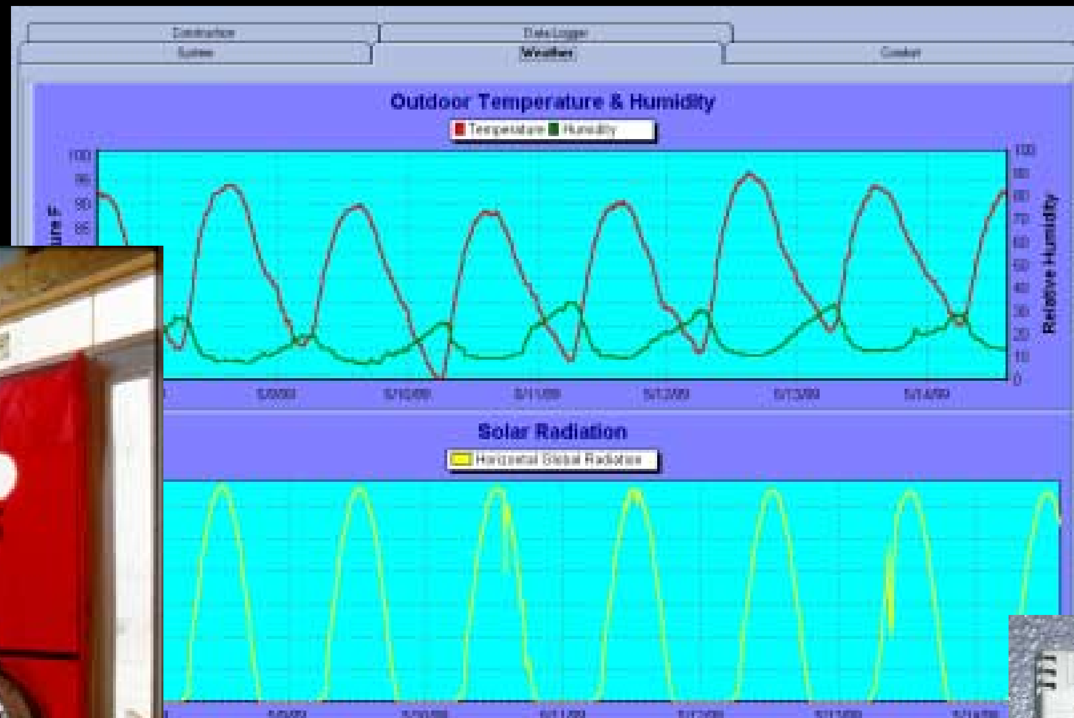
Performance Goals

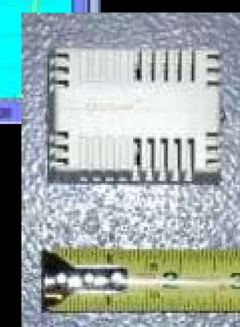
Energy	Reduce house energy consumption by 30% to 60%, depending upon climate.
Quality	Improve occupant comfort and health; increase design flexibility; improve durability and maintainability.
Efficiency	Design home for maximum benefits from building systems and products.
Time	Improve labor productivity and reduce construction time.
Costs	Minimal or no increase in construction costs.

Builder & Team Education

Through Pilot Homes

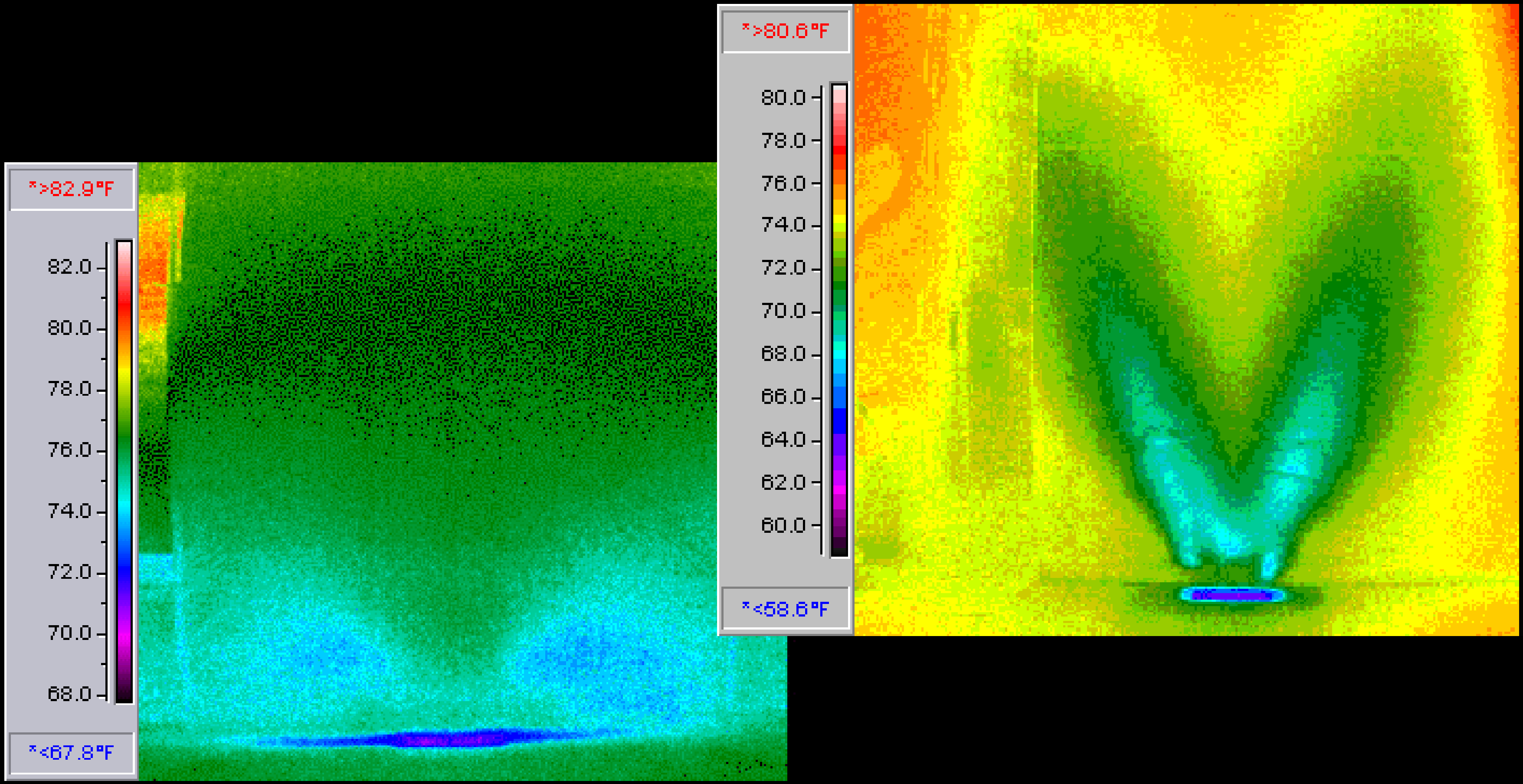
Developing Understanding





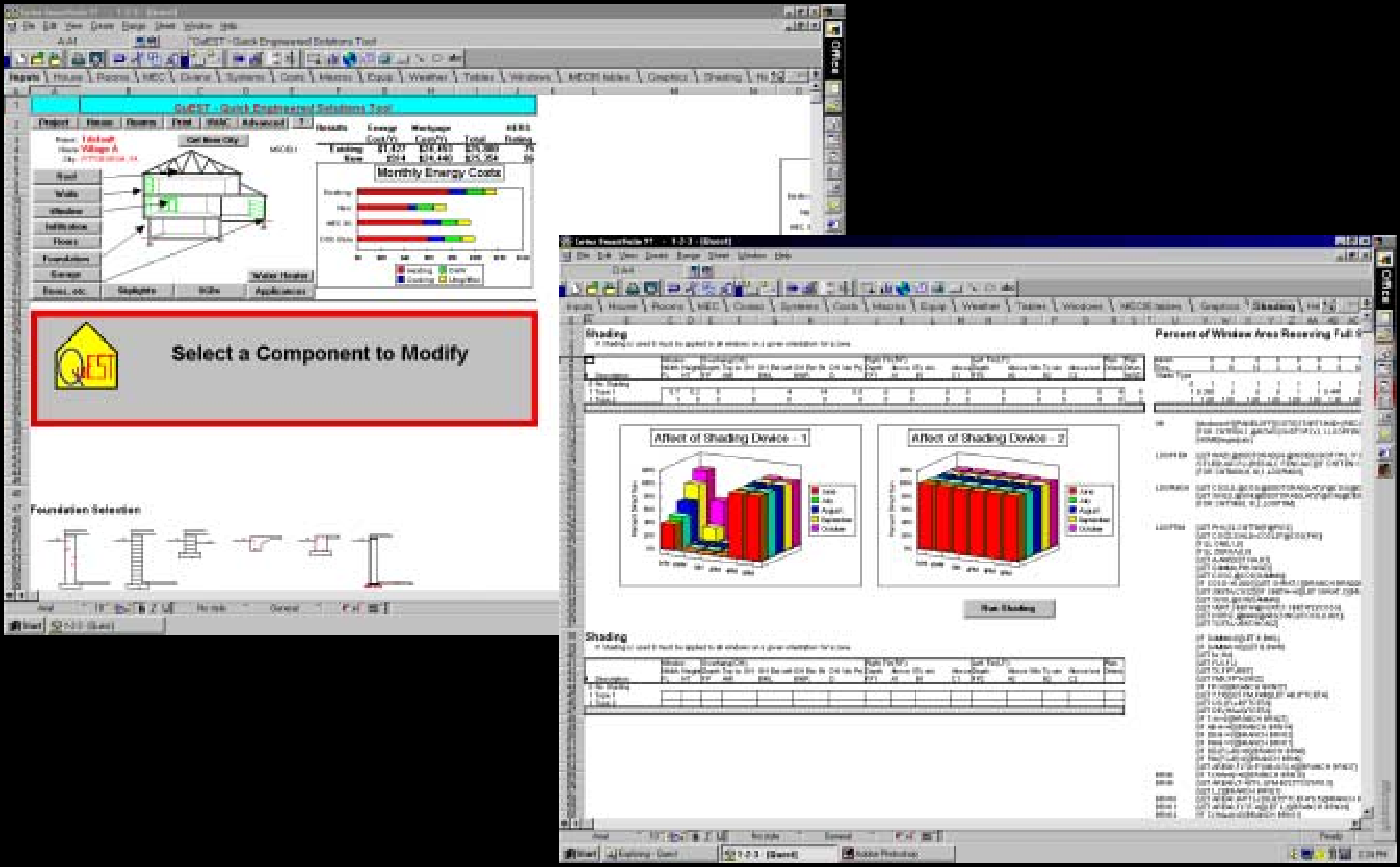
Through Pilot Homes

Including the Manufacturer



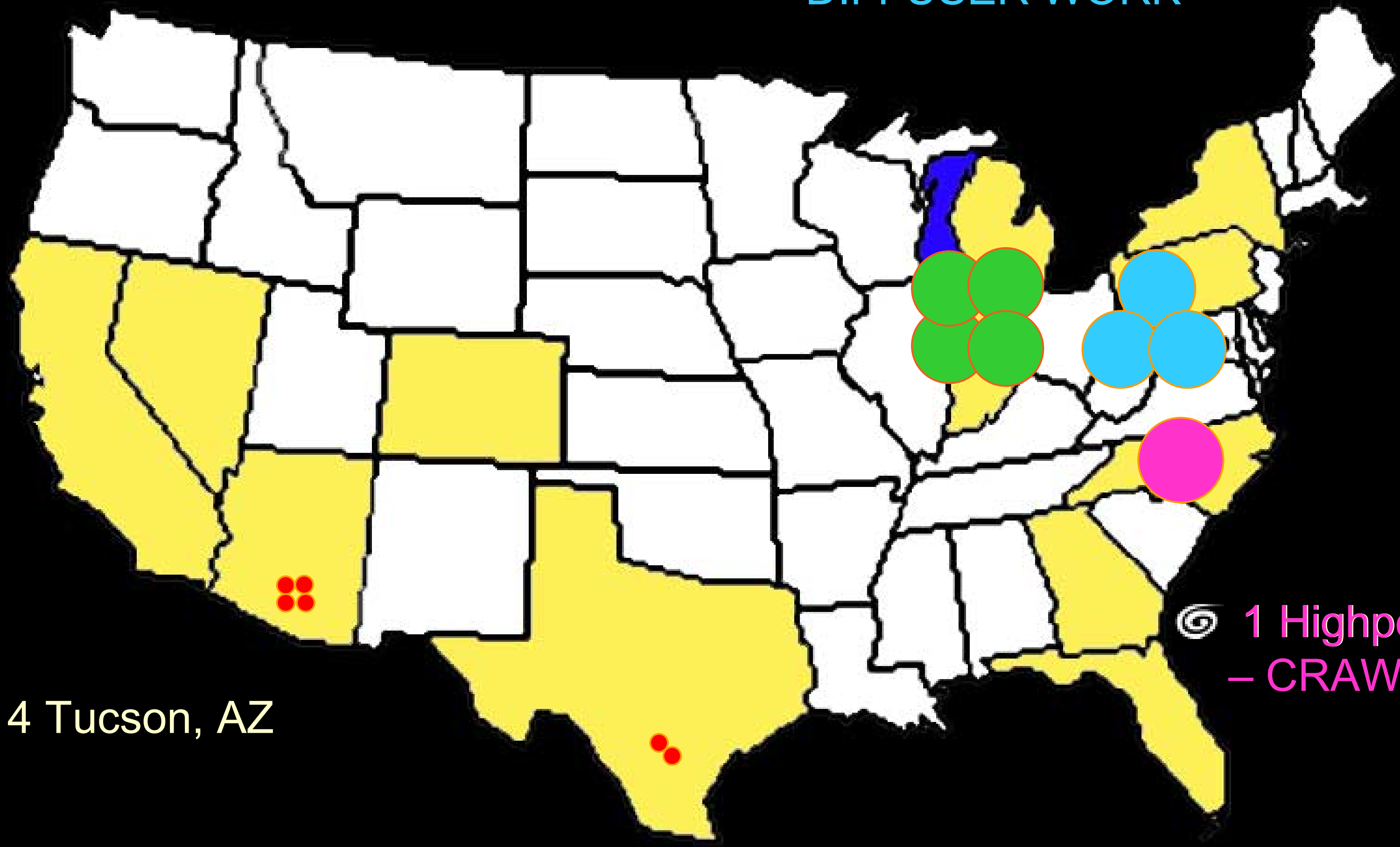
Building America reduction in heating & cooling loads make traditional design approaches ineffective

Developing Better Methods



Lab Homes

- 4 Indianapolis, IN - **VENTILATION**
- 3 Pittsburgh, PA – REGISTER & DIFFUSER WORK



- 1 Highpoint, NC – CRAWL SPACE
- 4 Tucson, AZ
- 2 Austin, TX

Ventilation

Provide adequate exchange of fresh air and direct exhaust of odors and moisture air at all times and allow homeowners to have operational control

- Potential options to customers to help them handle issues like asthma in the household
- Want highest performance system at reasonable cost (that they would pass on to customers)
- Reviewed four different mechanical ventilation systems to determine which is best for them
- HVAC contractor must easily install and service

Ventilation

Pilot Home 1 - 625 Model

- In-line Fan with On/Off Switch
- Continuous Operation subject to homeowner control
- Slight pressurization, counters infiltration

THE ESTRIDGE COMPANIES

Estimated Cost: $600

Ventilation

Pilot Home 2 - Outdoor Air to Furnace

- Outdoor Air Duct with Motorized Damper & Fan Recycler

- Air distributed through Supply ducts moved by periodic operation of Furnace Fan

Estimated Cost: $750, as installed $1000

THE ESTRIDGE COMPANIES

Ventilation

Pilot Home 3 - Heat Recovery Ventilator

- Heat Recovery Ventilator with Fan Recycler
- Periodic Operation

Estimated Cost: $1500

THE ESTRIDGE COMPANIES

Ventilation

Pilot Home 4 - Air Exchanger

- Air Exchanger Operating Continuously

Estimated Cost: $1000

THE ESTRIDGE COMPANIES

Ventilation Feedback

Estridge Customer Speaks Out

- Owner of Pilot Home #2 stated that the natural gas bills of her home were about half of what her immediate neighbors pay.
- Gas bills in neighboring homes were running at about $300-$350 per month. Their bill was around $150.
- She was impressed how little outdoor noise they hear. House is noticeably quieter and unaffected by outdoor sounds.

THE ESTRIDGE COMPANIES

Ventilation Feedback

IBACOS Viewpoint

- Ventilation should be modified by temperature conditions
- Comfort can be reduced as an issue when ventilation rate reduces in cold weather
- System can be integrated in many ways when peak temperature difference and Humidity difference is reduced

Ventilation

IBACOS Seasonal Response Ventilation Control

OBJECTIVES

- Accept that builders may not be able to build air-tight buildings, and develop a system that provides mechanical ventilation when natural infiltration is not adequate to maintain recommended IAQ standards.
- Meet basic ASHRAE 62.2 ventilation rates.
- Use infiltration to replace mechanical ventilation whenever possible.
- Reduce over-ventilation.
- Reduce overall annual energy use created by combined ventilation and infiltration loads to a practical minimum.

Ventilation

IBACOS Seasonal Response Ventilation Control

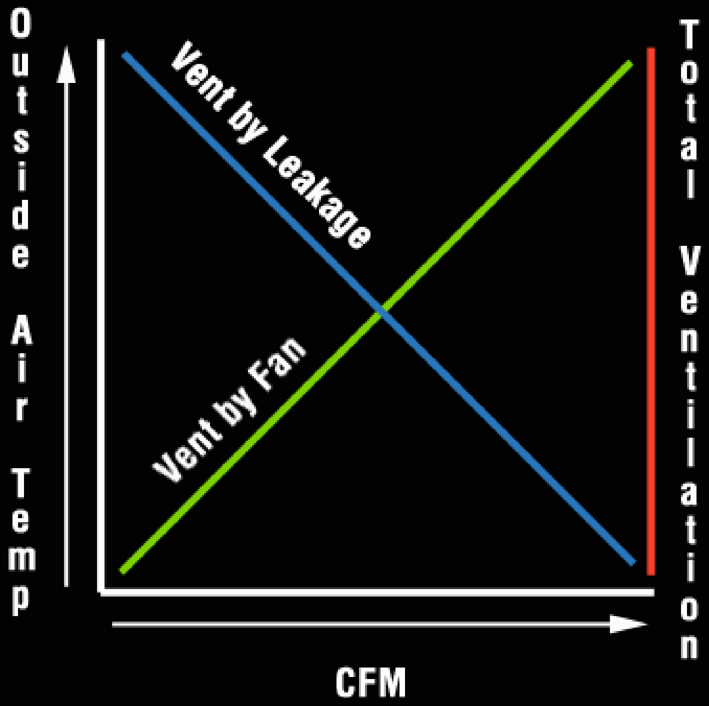
APPROACH

- Establish desired, continuous ventilation rate, without any infiltration credit.
- Determine infiltration air flow at any given outdoor temperature
- Determine maximum ventilation rate of combined fan flow and infiltration at a given outdoor temperature.
- Determine fan run time to provide an overall hourly ventilation rate equal to the required rate from a combination of fan flow and infiltration at a given outdoor temperature.

Ventilation

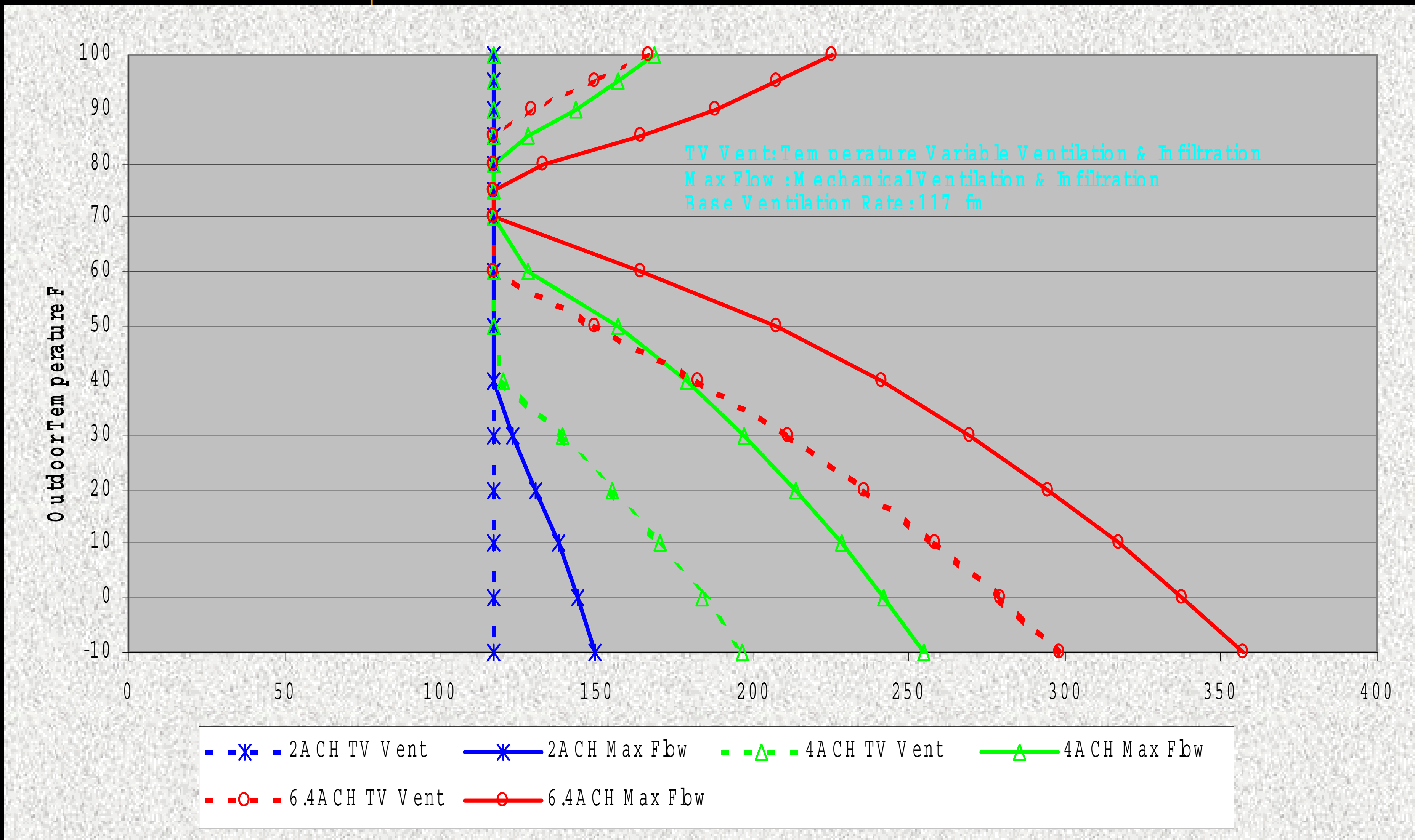
ASHRAE – Farm Development, Myers House

Project:	Farm Development	
House Model:	Myers House	
Location:	Poughkeepsie, NY	
Floor Area:	2650 sq.ft.	
Height:	2 Story	
No. Bedrooms:	4	
Design Indoor Temp:	Winter – 70 º	Summer – 75 º
Design Outdoor Temp:	Winter – - 6 º	Summer – 89 º
Range for Analysis:	100º to –10 º F	
Equivalent Leakage Area (ELA):	127 sq. in. (at target of 4ACH50)	
Stack Coefficient:	0.0299 (2 story house)	
Base Ventilation Rate:	117 cfm	



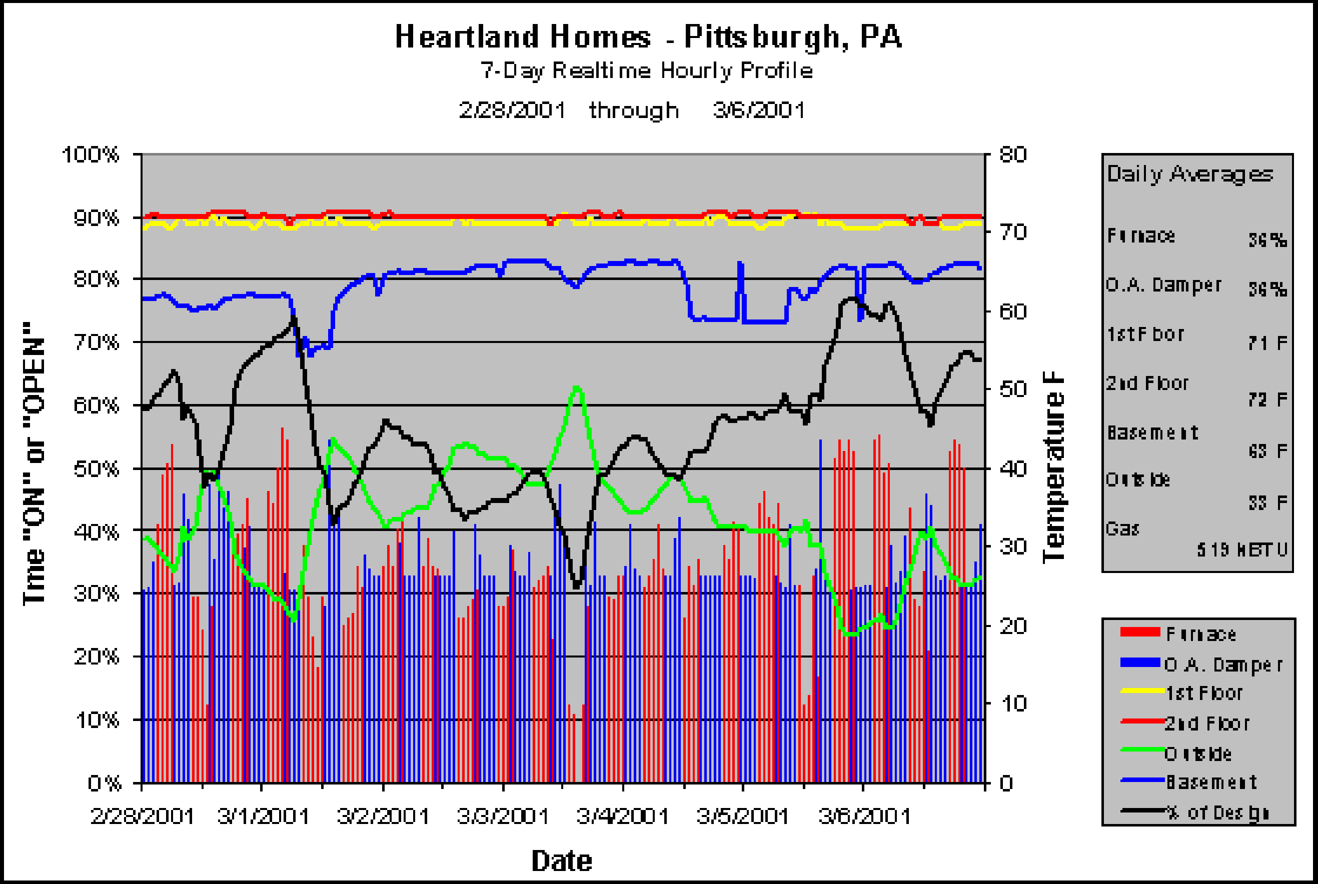
Ventilation

Farm Development, Myers House
Poughkeepsie, NY



Sizing Study/ Basement Insulation

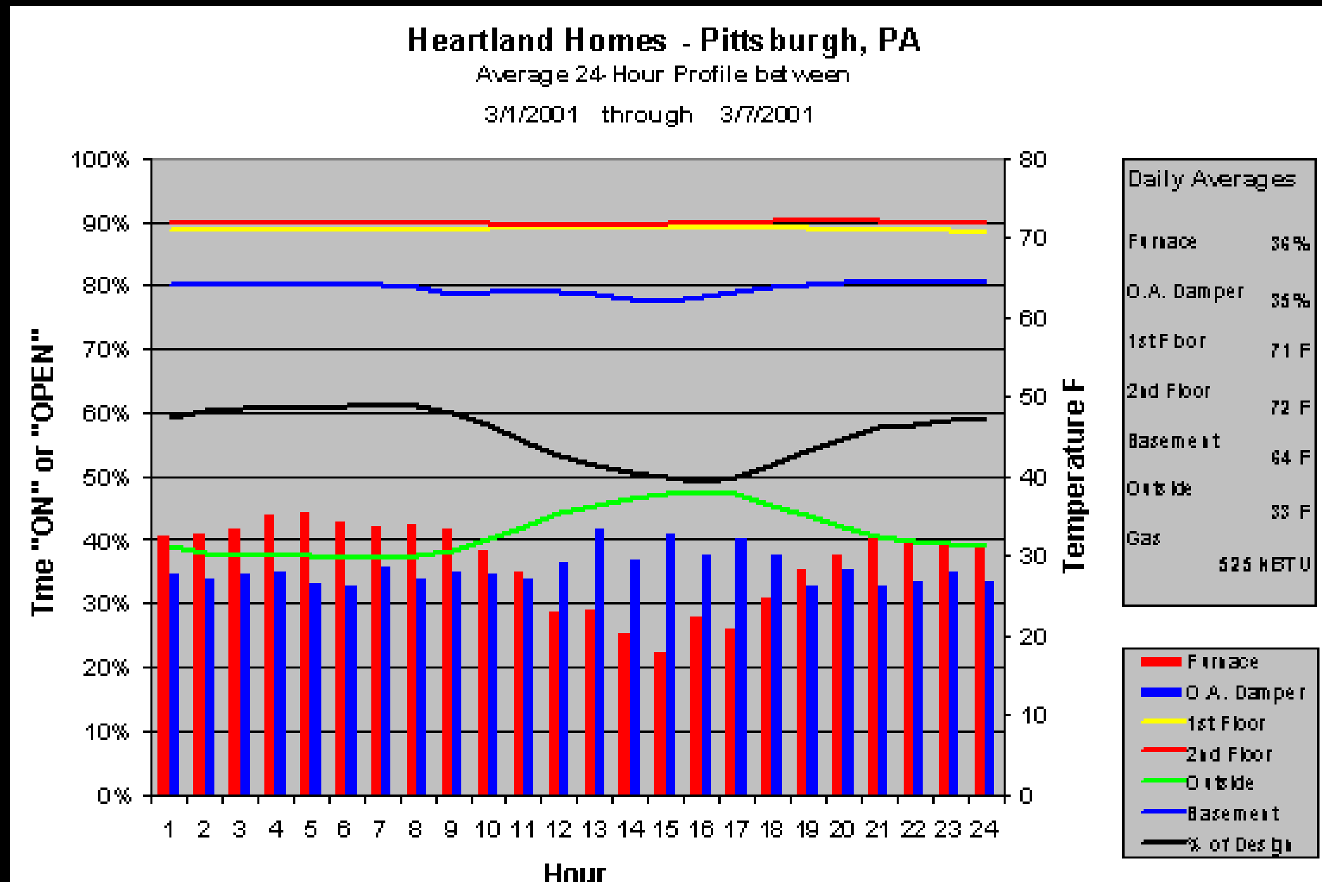
Real-time data is reviewed to identify anomalies and subtle trends that do not appear in averaged data. This data was recorded during the last phase of construction, before and after the basement insulation was installed.



A noticeable change in the basement temperature (61^0F – 66^0F) was measured as a result of basement insulation.

Additionally, Indications show a 10% reduction in overall heating energy from 585 kBTU/day to 524 kBTU/day.

Sizing Study/ Basement Insulation



By looking at this we can quickly tell that a smaller furnace would have been too small and that the installed furnace will have a comfortable margin of extra capacity at design conditions.

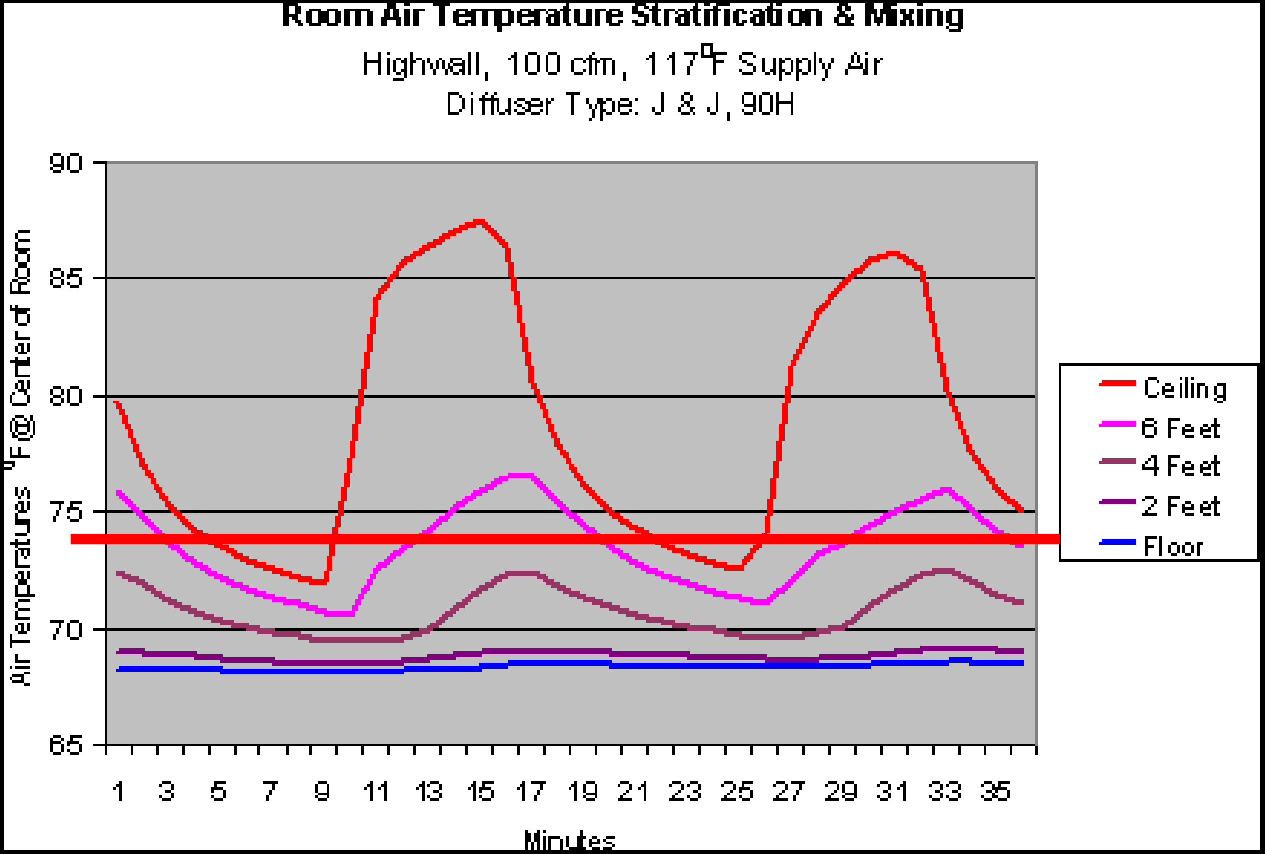
Register & Diffuser Work

Lab Pilot - Objectives

- Avoid testing diffusers in occupied homes under field conditions
- Facilitate comparative studies
- Provide for use of smoke for visual evaluation
- Automate data collection of air temperatures
- Conduct accelerated 2-season studies

Register & Diffuser Work

Lab Pilot – Stratification Issues



Supply air was cycled on and off to maintain a temperature of 70^{0}F to 71^{0}F. This combination of diffuser and supply air temperature produced the worst stratification of the three that were tested. Peak stratification within the occupied zone (floor - 6 feet) was almost 9^{0}F near the end of each heating cycle.

Register & Diffuser Work

Lab Pilot – Air Delivery

Test No.:	5a
Mode:	Heating
Diffuser:	J & J, 90H
Airflow:	100 cfm
Temps:	Supply air – 95^{0}F Room air- 70^{0}F
Elapsed Time:	3 seconds
Notes:	Low return

Air is delivered with sufficient throw velocity to force heated primary air to the 4 foot level, but buoyancy causes the air to rise back up preventing any mixing in the occupied zone below 5 feet.

Register & Diffuser Work

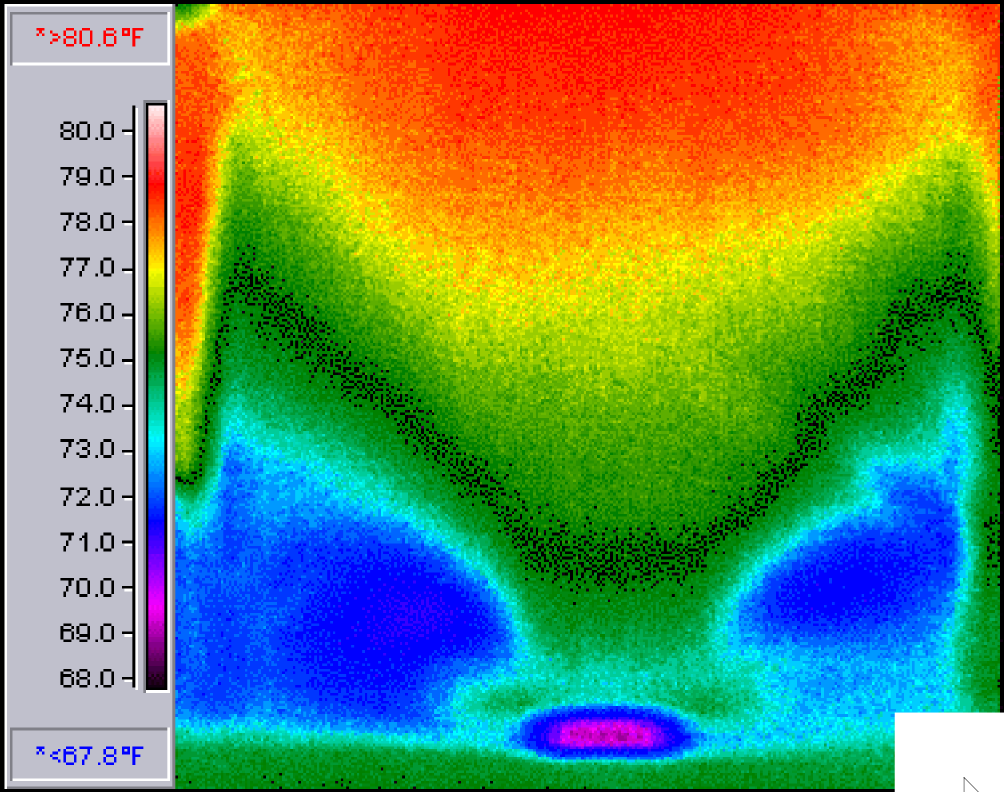
Lab Pilot – High-velocity / High-wall location

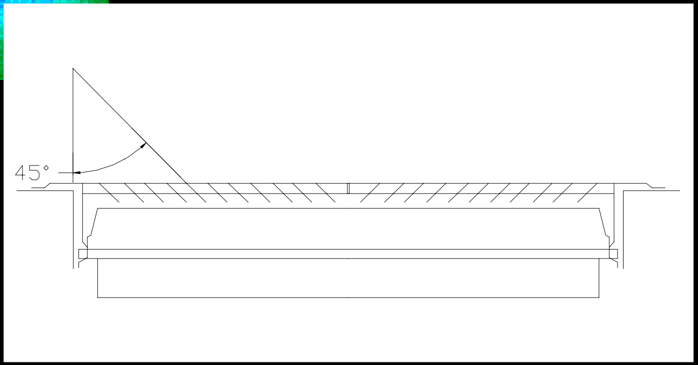
Test No.:	7a
Mode:	Heating
Diffuser:	2" nozzle
Airflow:	60 cfm
Temps:	Supply air – 128^{0}F Room air- 70^{0}F
Elapsed Time:	2 seconds
Notes:	

Primary air is easily projected across the room and into the target wall. Velocity at nozzle is 1440 fpm at a total pressure drop of 62 pascals.

Register & Diffuser Work

Field Work - Carrier Homes



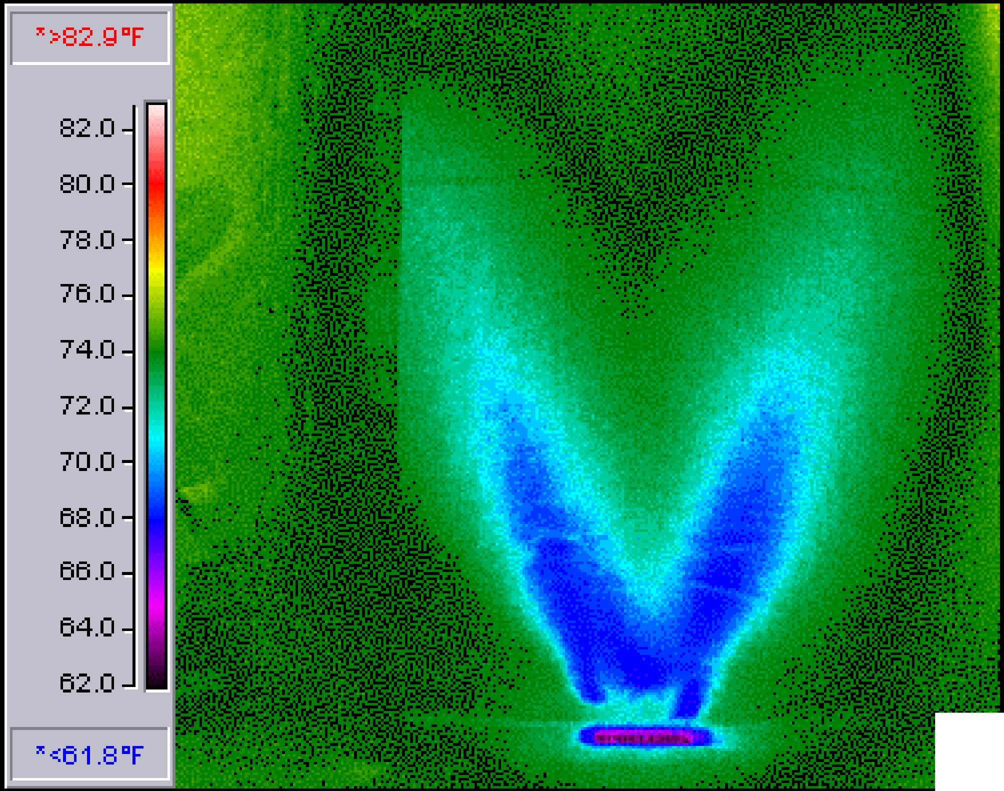


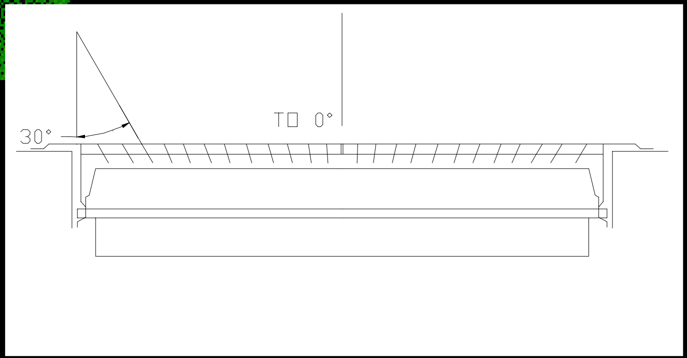
Airflow

	Low	High
Equipment	900	1600
Delivered	471	842

Register & Diffuser Work

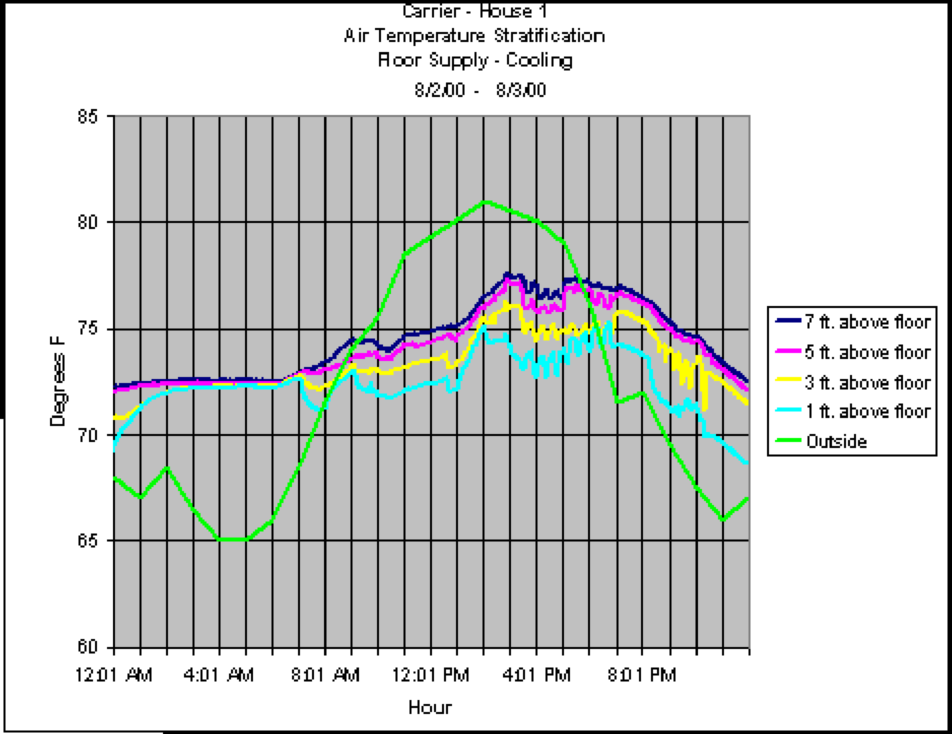
Field Work - Carrier Homes

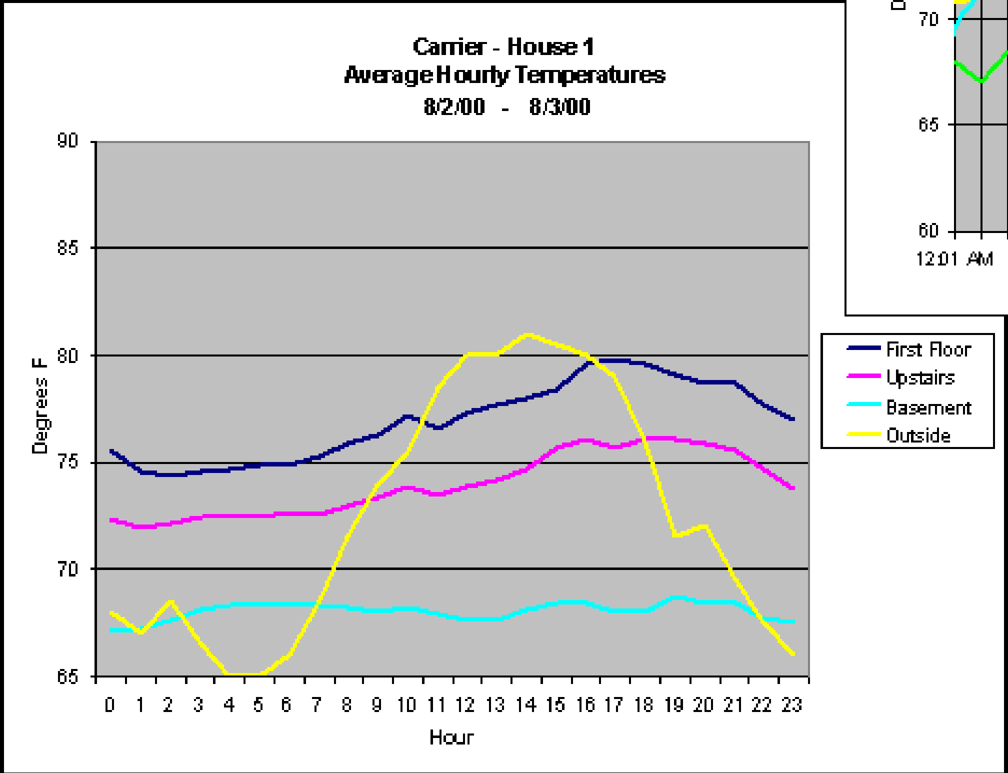




Register & Diffuser Work

Field Work - Carrier Homes





Crawl Spaces

Fortis Viewpoint

- Have always put vents in crawl space walls as per North Carolina code
- Management had personal experience with mold growth in crawl space of own home
- Look at possible ways to avoid potential health and liability issues
- Must consider local climatic conditions and code requirements

FORTIS Homes

Crawl Spaces

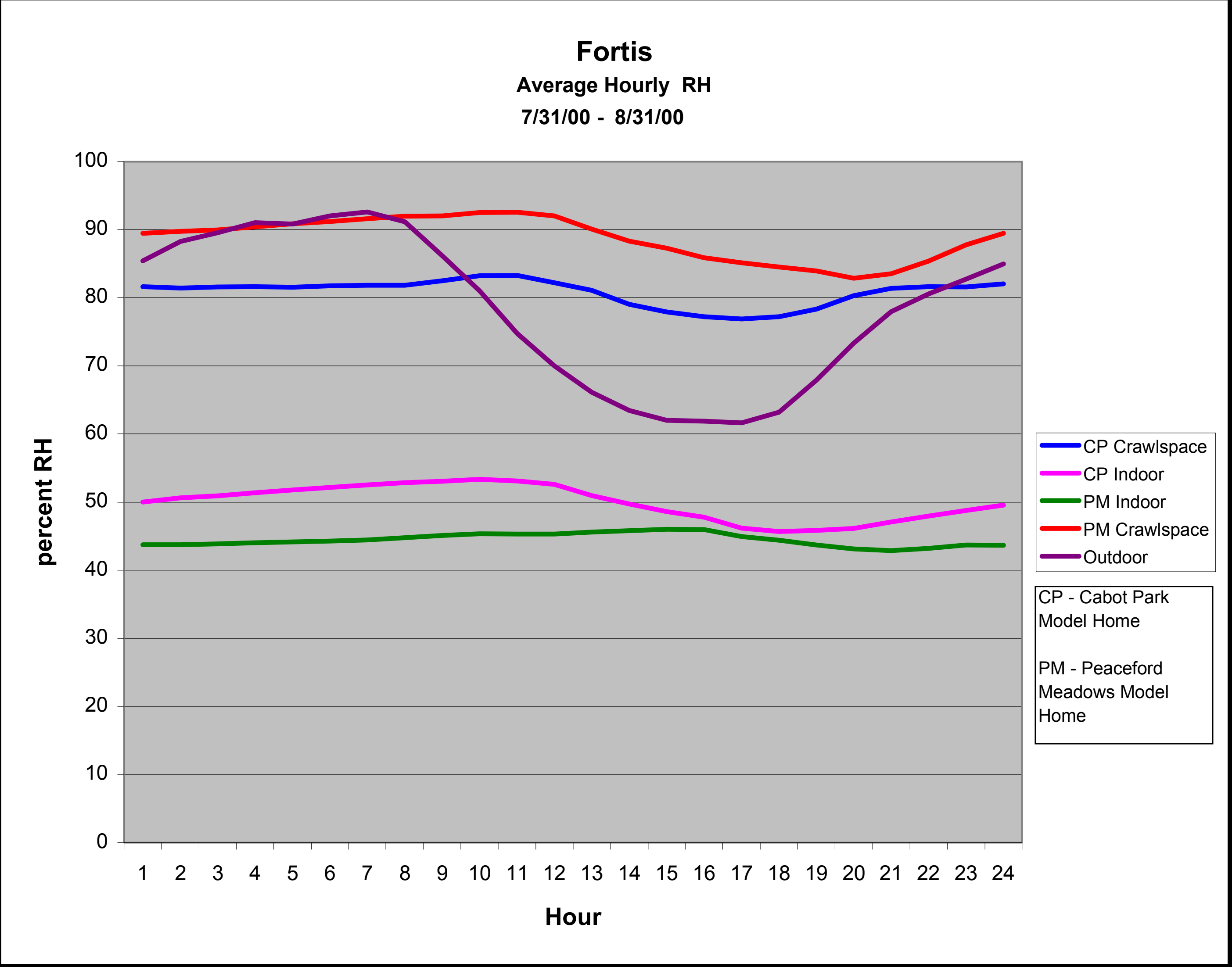
- Moisture coming through vents especially in summer
- Moisture coming through foundation wall
- Moisture coming through gaps in ground cover

The Problem

Crawl Spaces

Monitoring the Issue

- Sensors in two homes
- Monitor vented crawl space and indoor humidity levels in each
- Humidity in crawl space mostly between 80% and 92%



FORTIS Homes

Crawl Spaces

Solving the Issue

- Vents eliminated
- Crawl Access door made airtight

Crawl Spaces

Solving the Issue

- Treat as Short Basement
- Insulate Walls not Floor

Communities

Community Partners

Civano
Tucson, AZ

Coffee Creek
Chesterton, IN

Summerset
Pittsburgh, PA

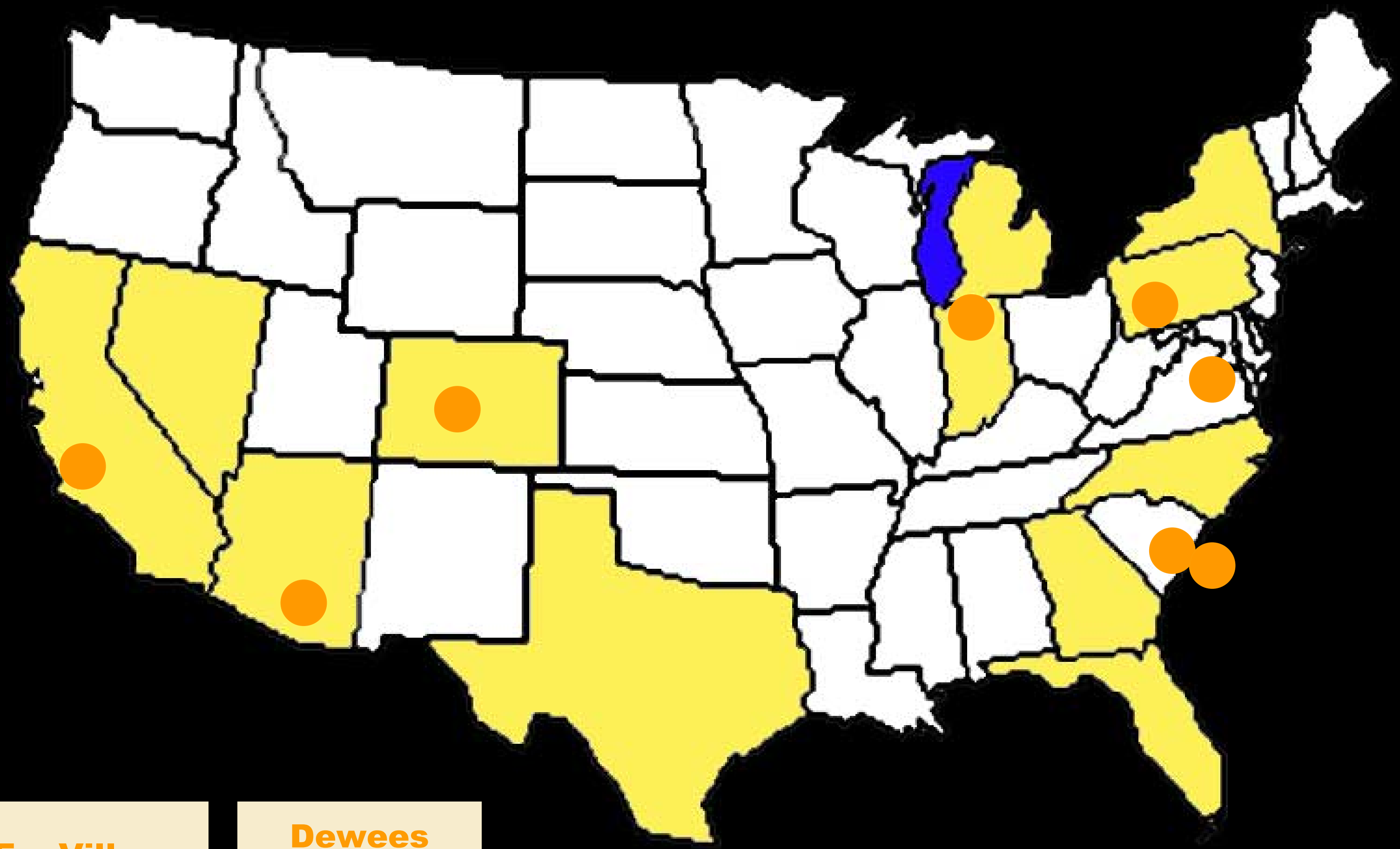
Playa Vista
Los Angeles, CA

Noisette
Charleston, SC

Stapleton
Denver, CO

EcoVillage
VA

Dewees Island
SC



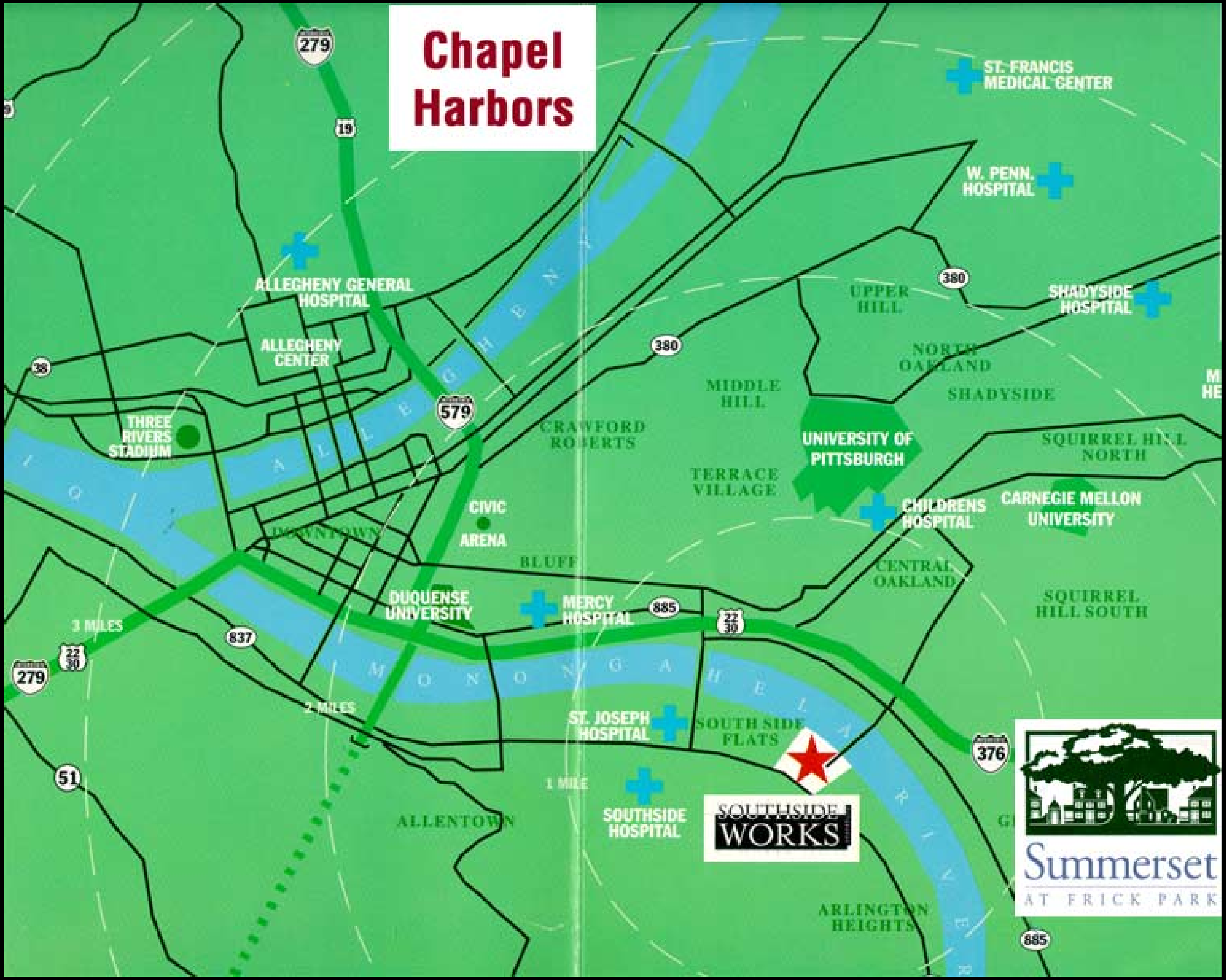
Communities Vs Houses

Scale of Everything is bigger

Community	Builder
Four to six builders	One
Non Competing Markets	Competition
Four Years to Ground Breaking	One to two
Ten Years to build	Three Avg
700 to 13,000 in Ten Years	400 in Six
Market Based Ripple Effect	Marketing

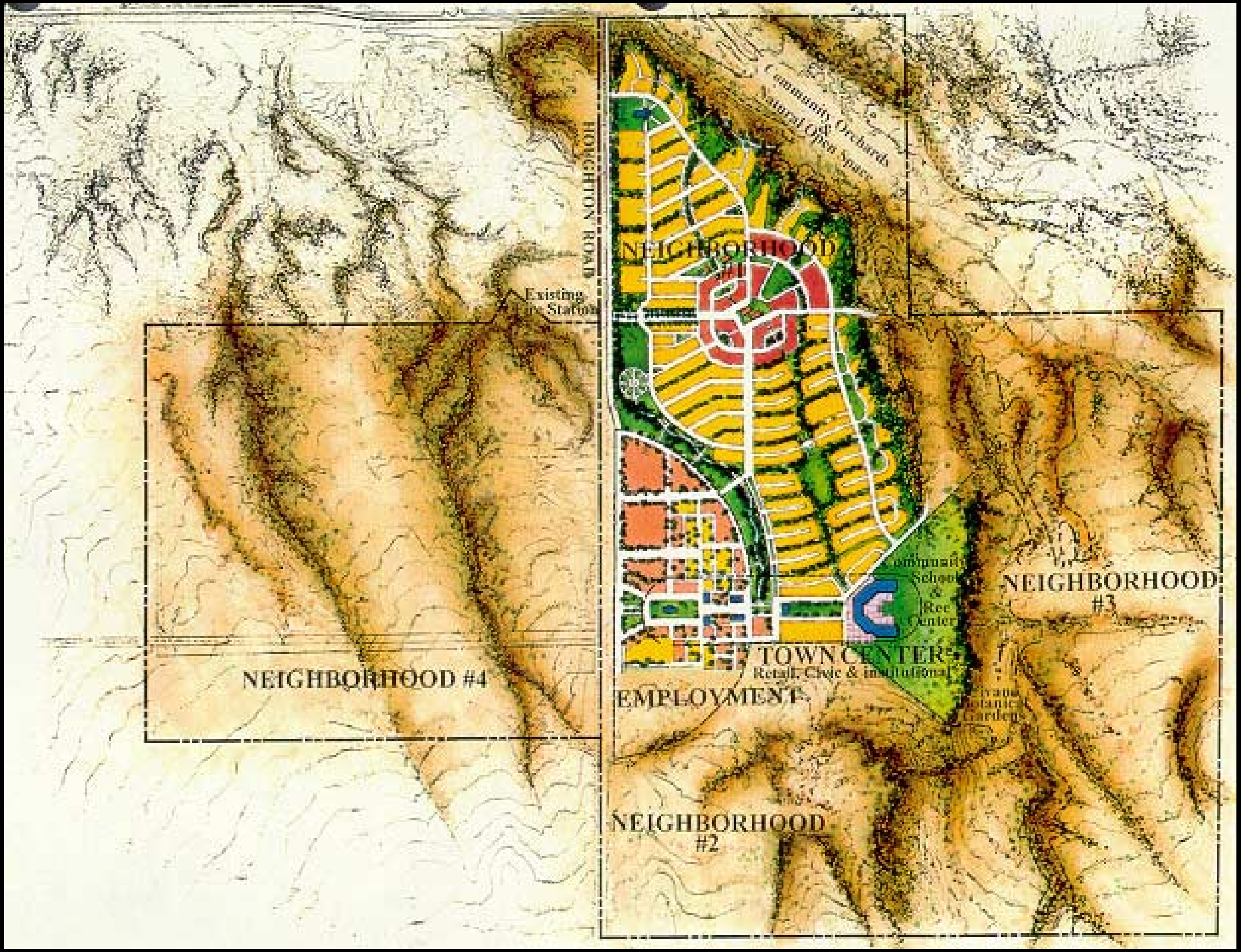
Communities

Success = Leverage



Communities

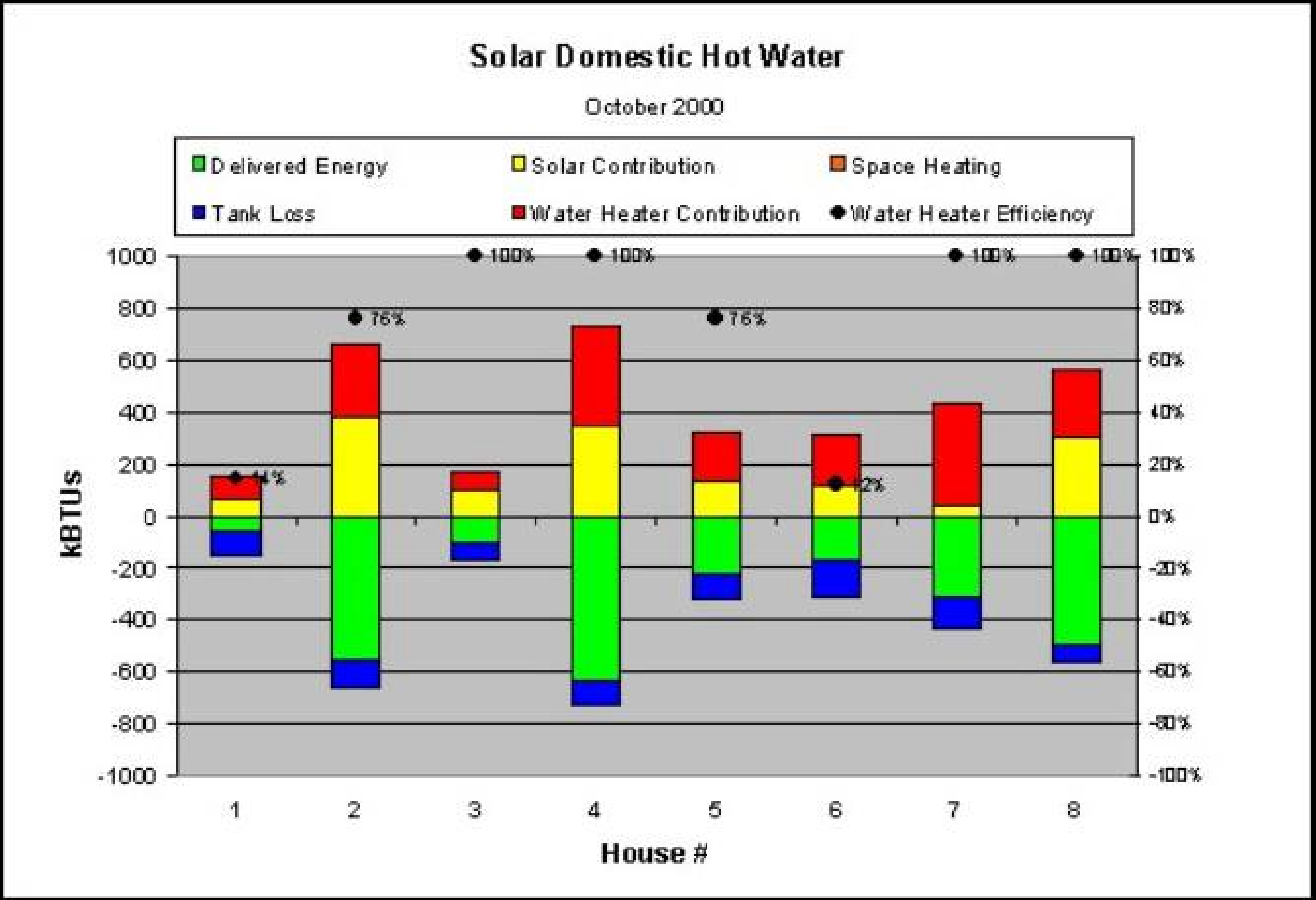
Civano – Tucson, AZ



Communities

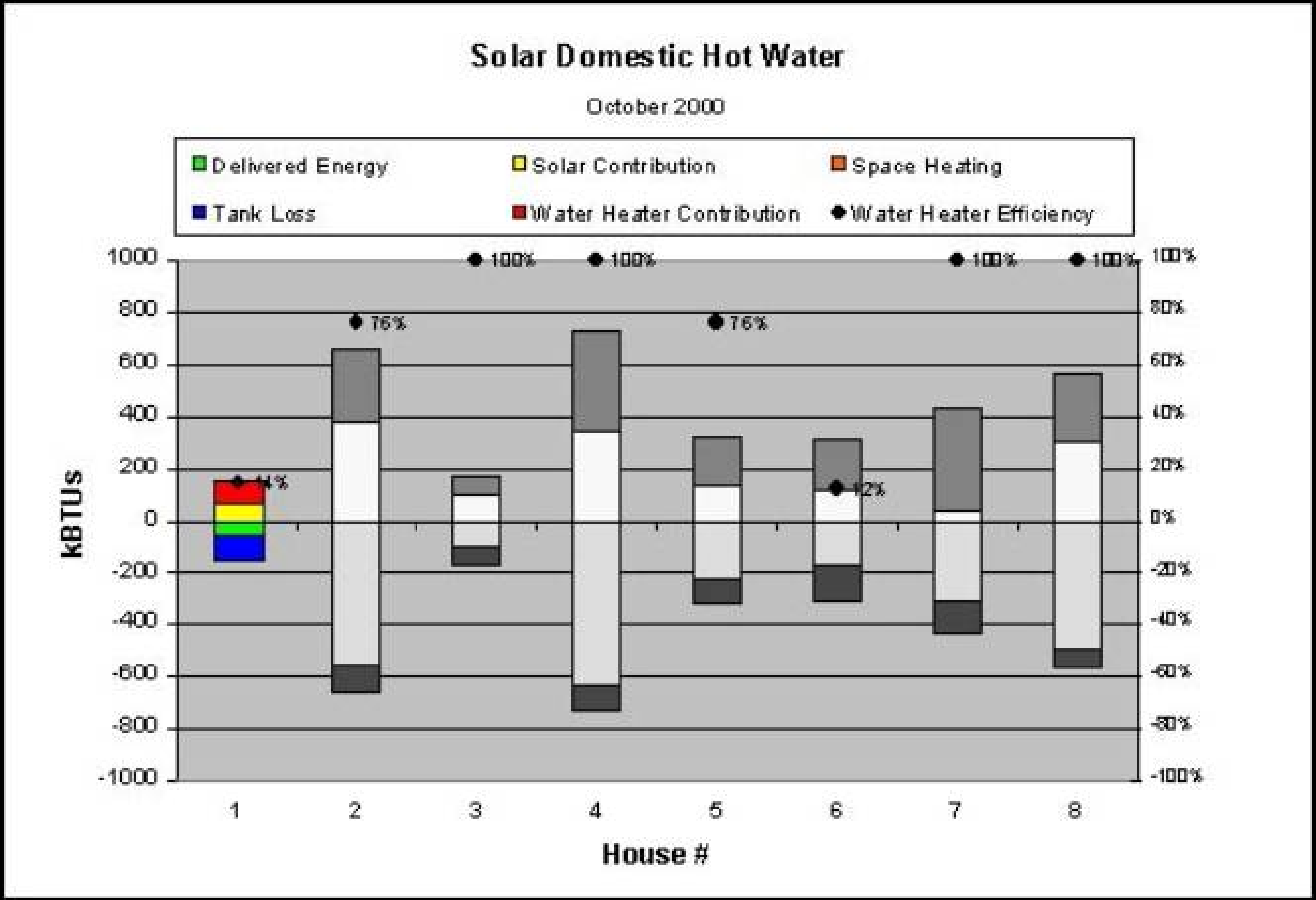
Civano – Solar Contribution

An ongoing study of 8 homes Civano shows interesting correlations between occupant behavior, system type, and the calculated Solar Contribution (SC). Each house is equipped with a 40 gallon Integrated Collector Storage (ICS) system and conventional 40 gallon water heater. The 4 electric water heaters are identified as the systems with 100% efficient water heaters. Reduced efficiencies on gas models are due to flue losses.



Communities

Civano – Solar Contribution

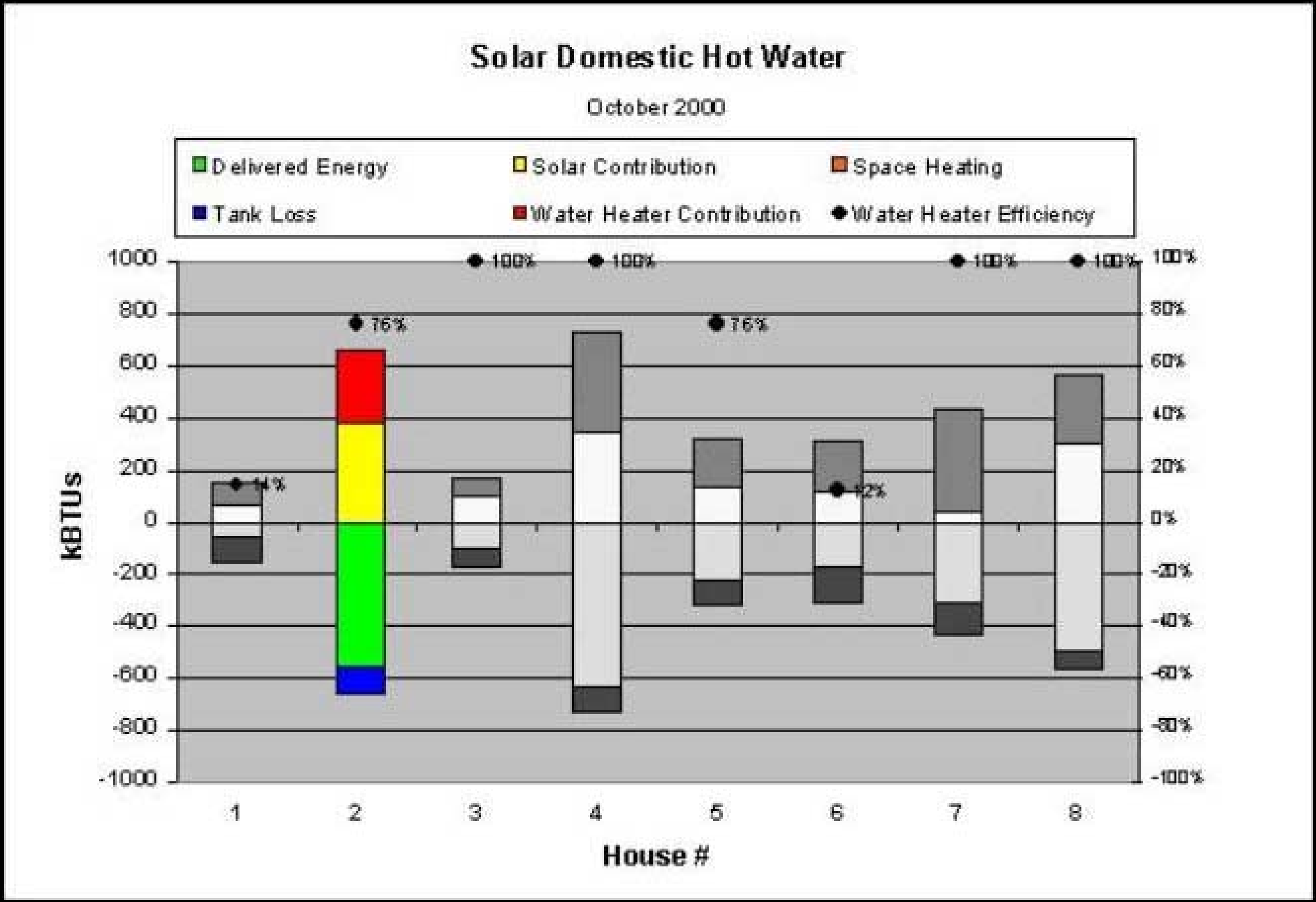


House 1

<u>A.M. Consumption</u>	<u>P.M. Consumption</u>	<u>Observations</u>
Very Low	Very Low	Although SC accounts for 41% of this small load, gas water heater efficiency drops to 14% under low-consumption, long-standby conditions

Communities

Civano – Solar Contribution

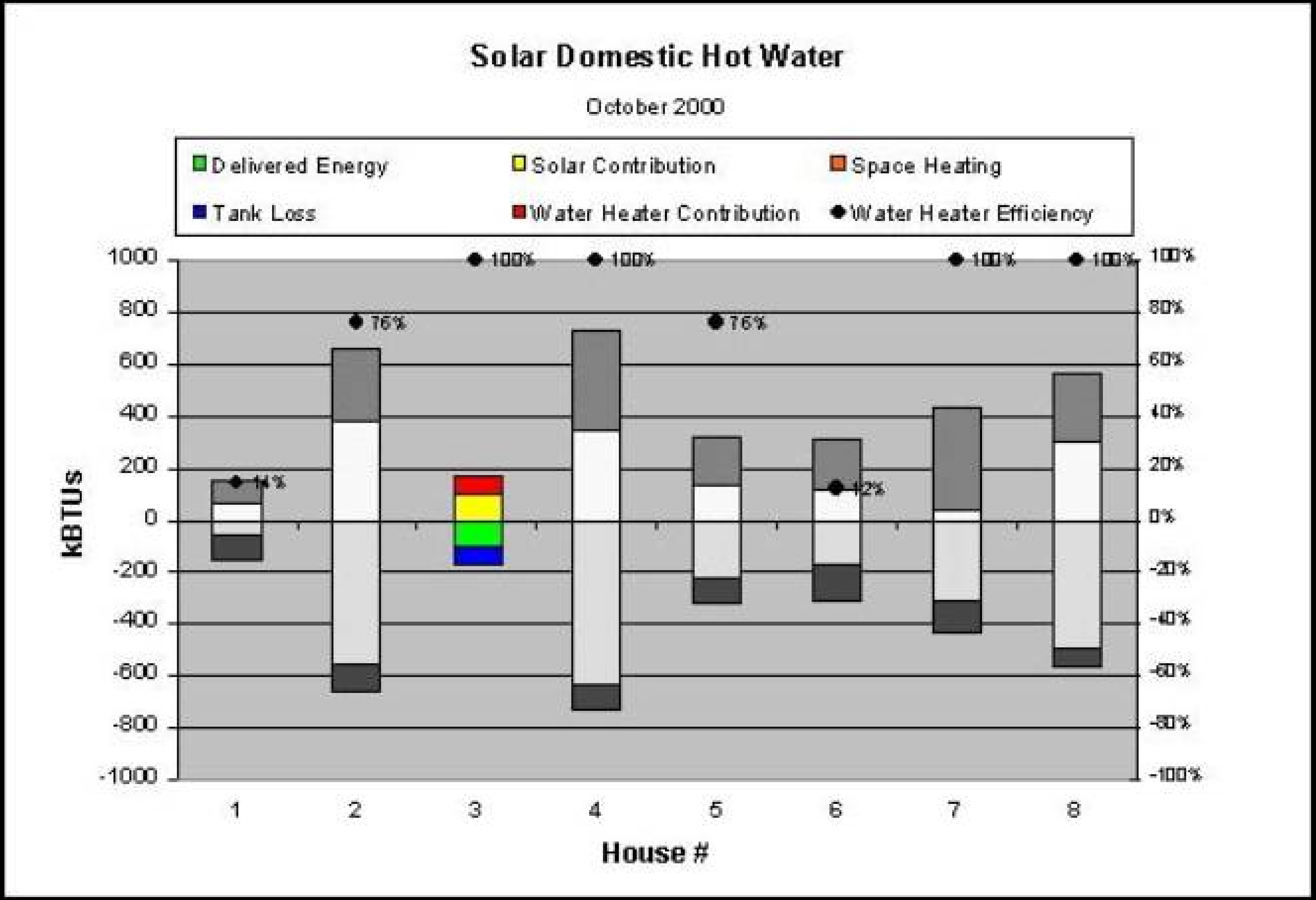


House 2

A.M. Consumption	P.M. Consumption	Observations
High	High	SC is approximately 47%, gas water heater efficiency optimized by high consumption

Communities

Civano – Solar Contribution

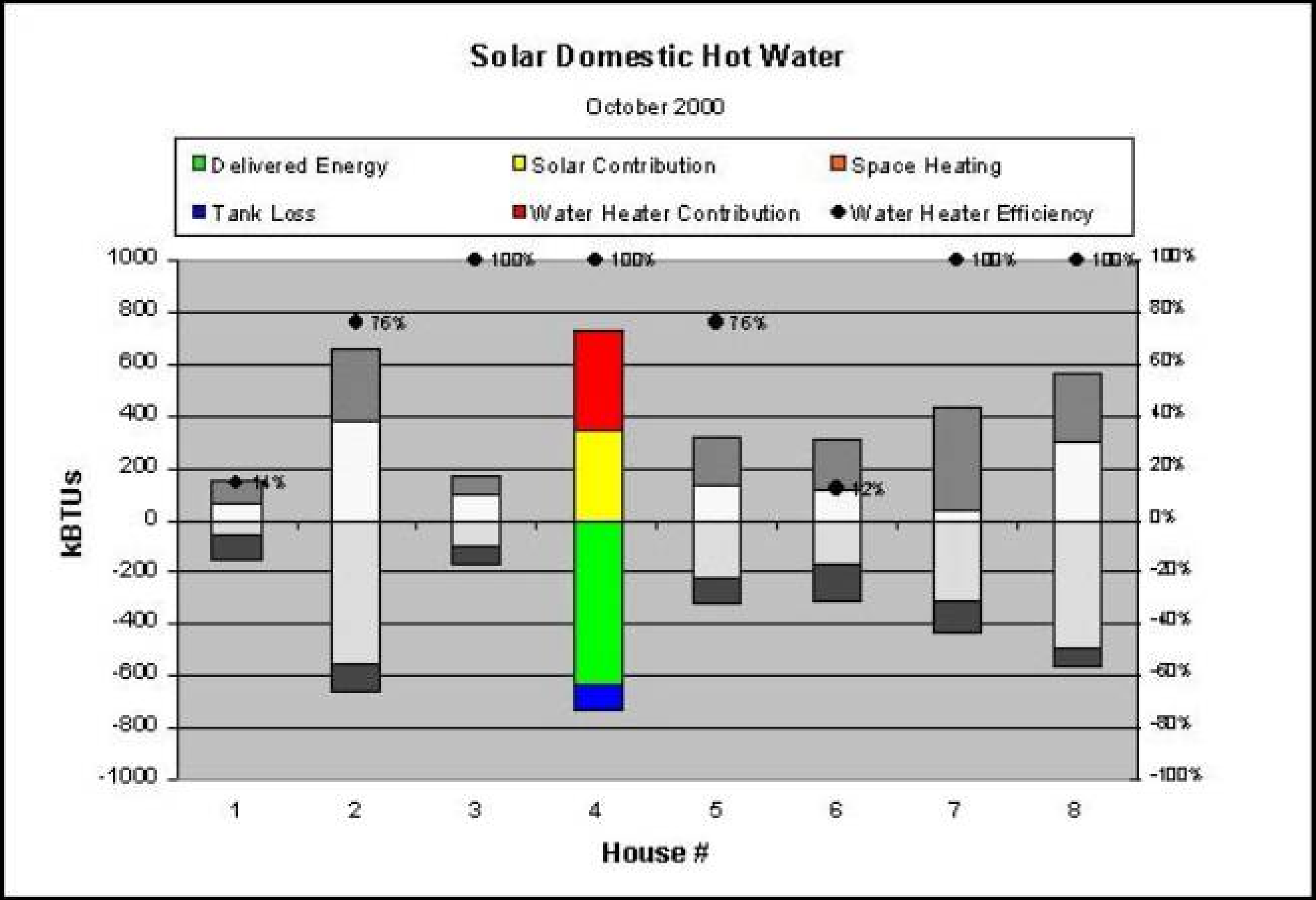


House 3

A.M. Consumption	P.M. Consumption	Observations
Low	Low	Low tank temperature (104^0F) helped boost SC to 60%, electric water heater appears to have an advantage over gas in low-consumption conditions.

Communities

Civano – Solar Contribution

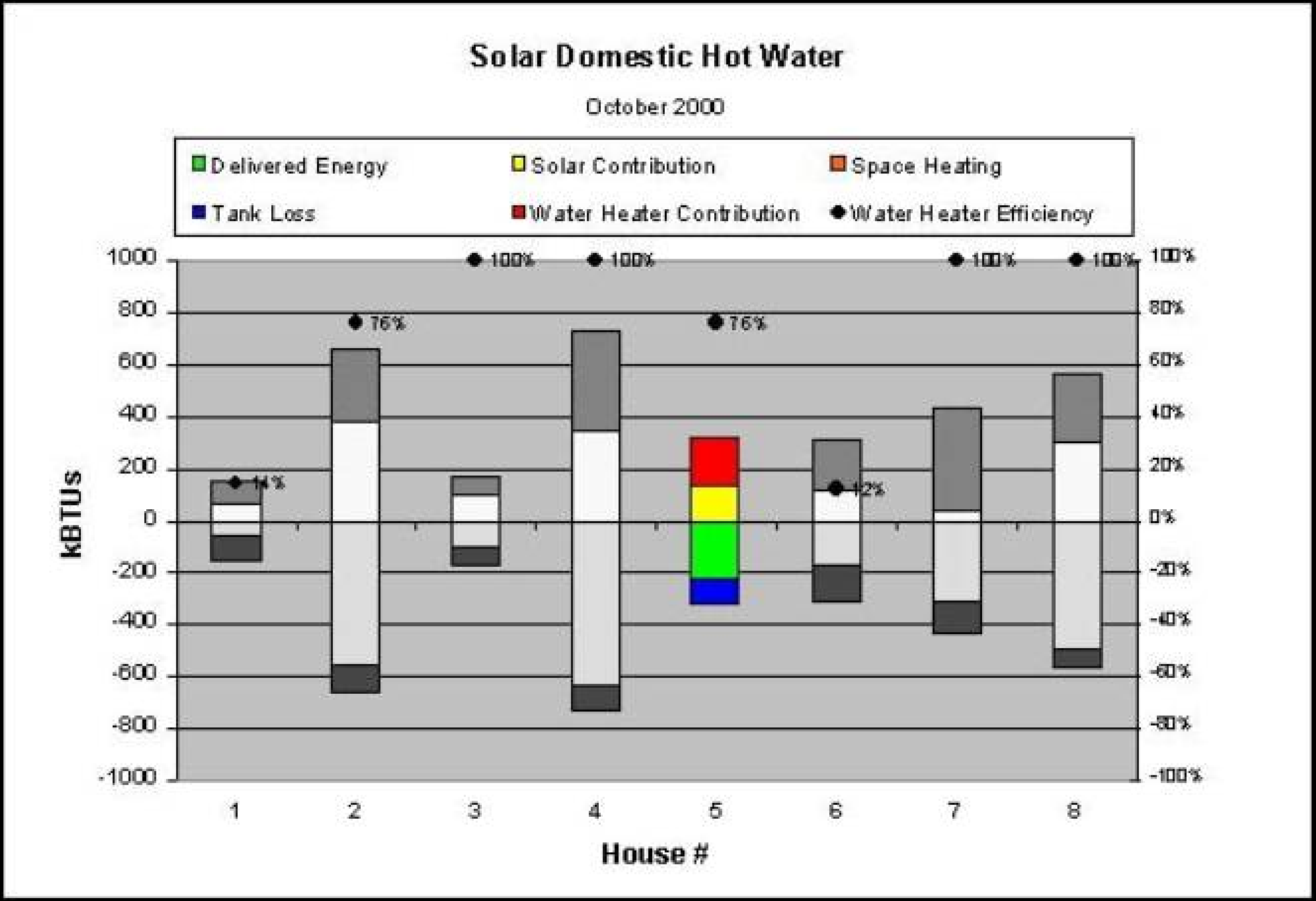


House 4

A.M. Consumption	**P.M. Consumption**	**Observations**
High	**High**	**SC is approximately 58%**

Communities

Civano – Solar Contribution

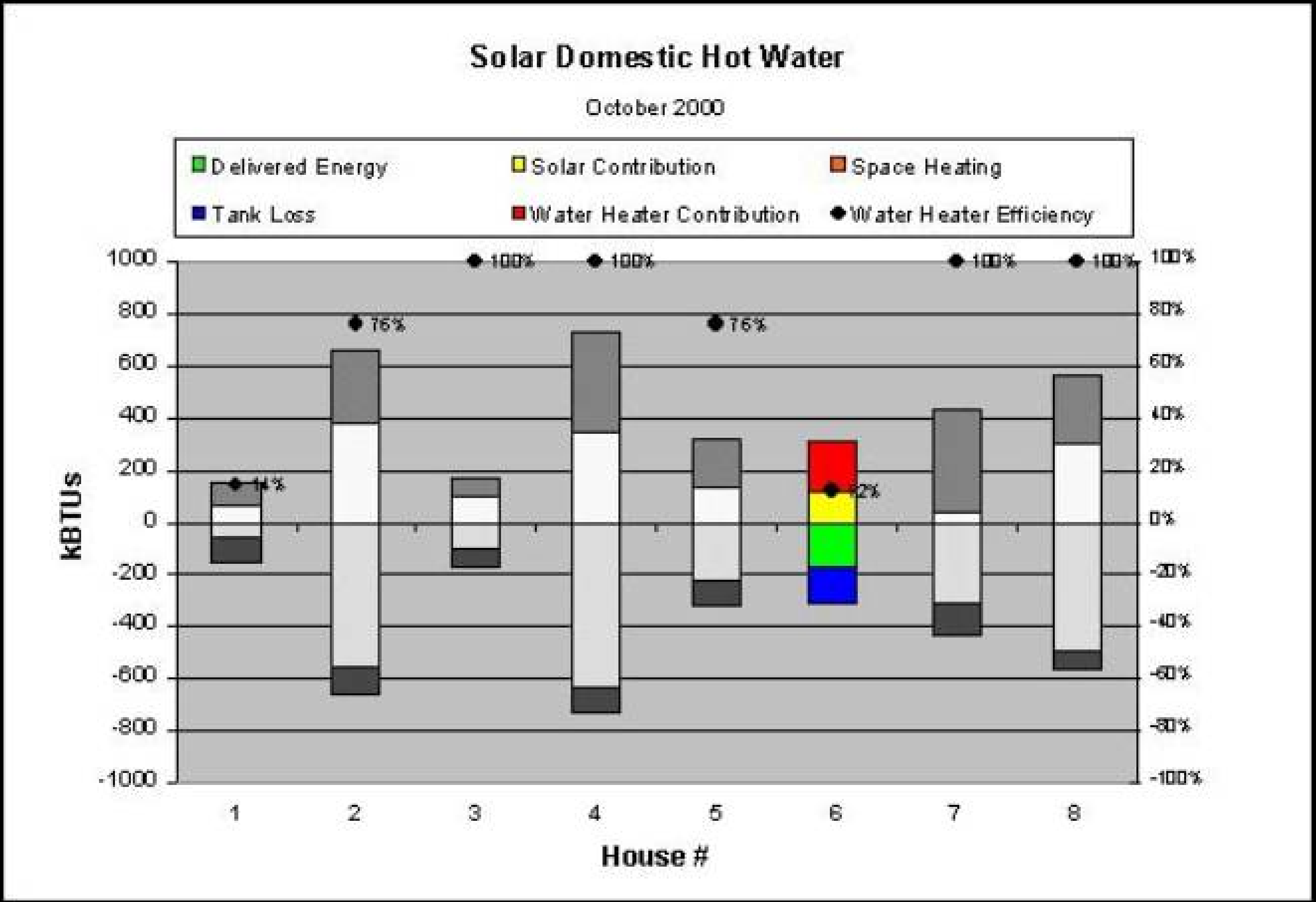


House 5

A.M. Consumption	P.M. Consumption	Observations
Moderate	Low	Integrated hydronic heating system optimizes water heater efficiency and boosts the SC to 43%

Communities

Civano – Solar Contribution

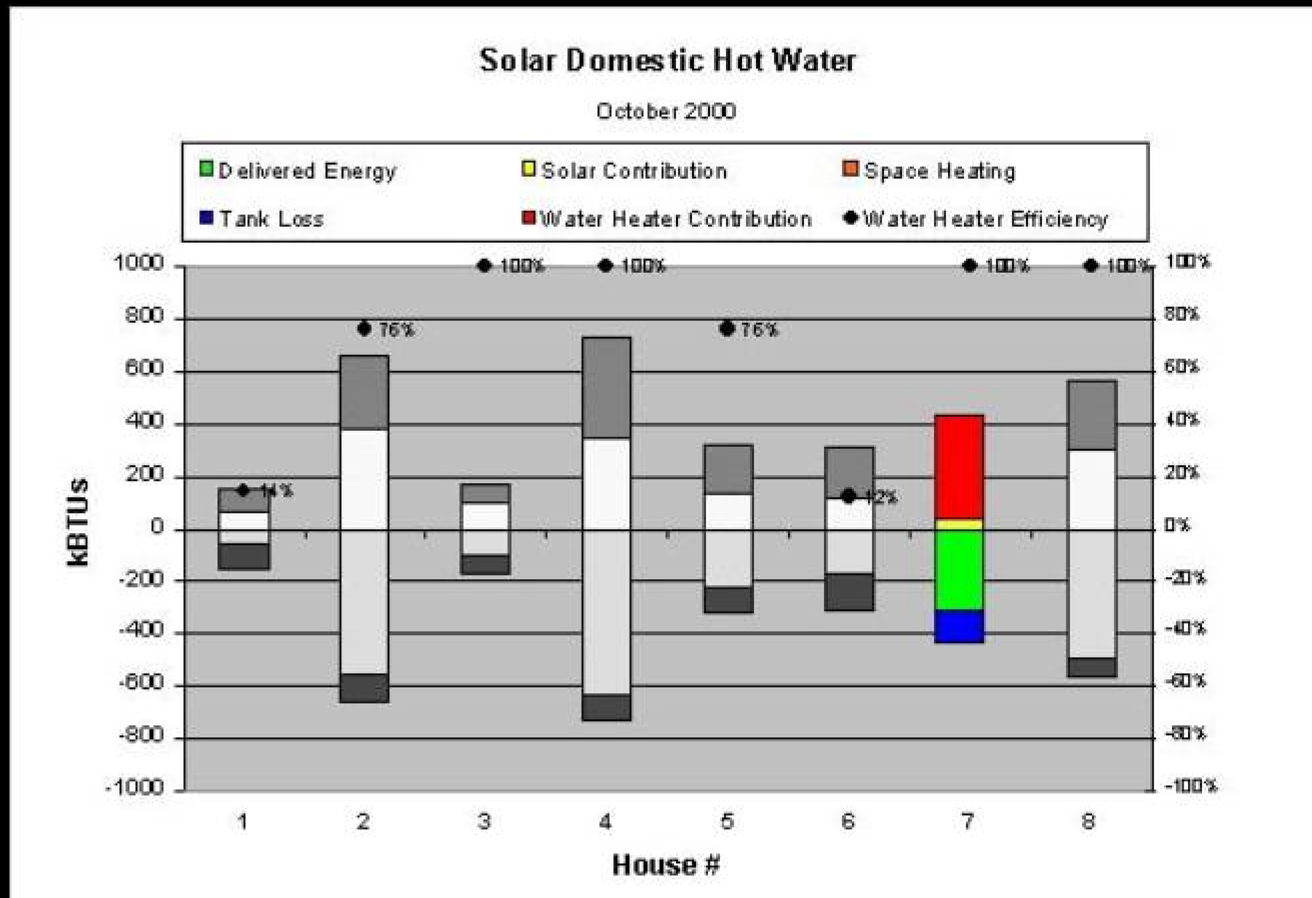


House 6

A.M. Consumption	**P.M. Consumption**	**Observations**
Low	**Very Low**	**Although SC accounts for 38% of this small load, high delivery temperature (136^{0}F) combined with low**

Communities

Civano – Solar Contribution

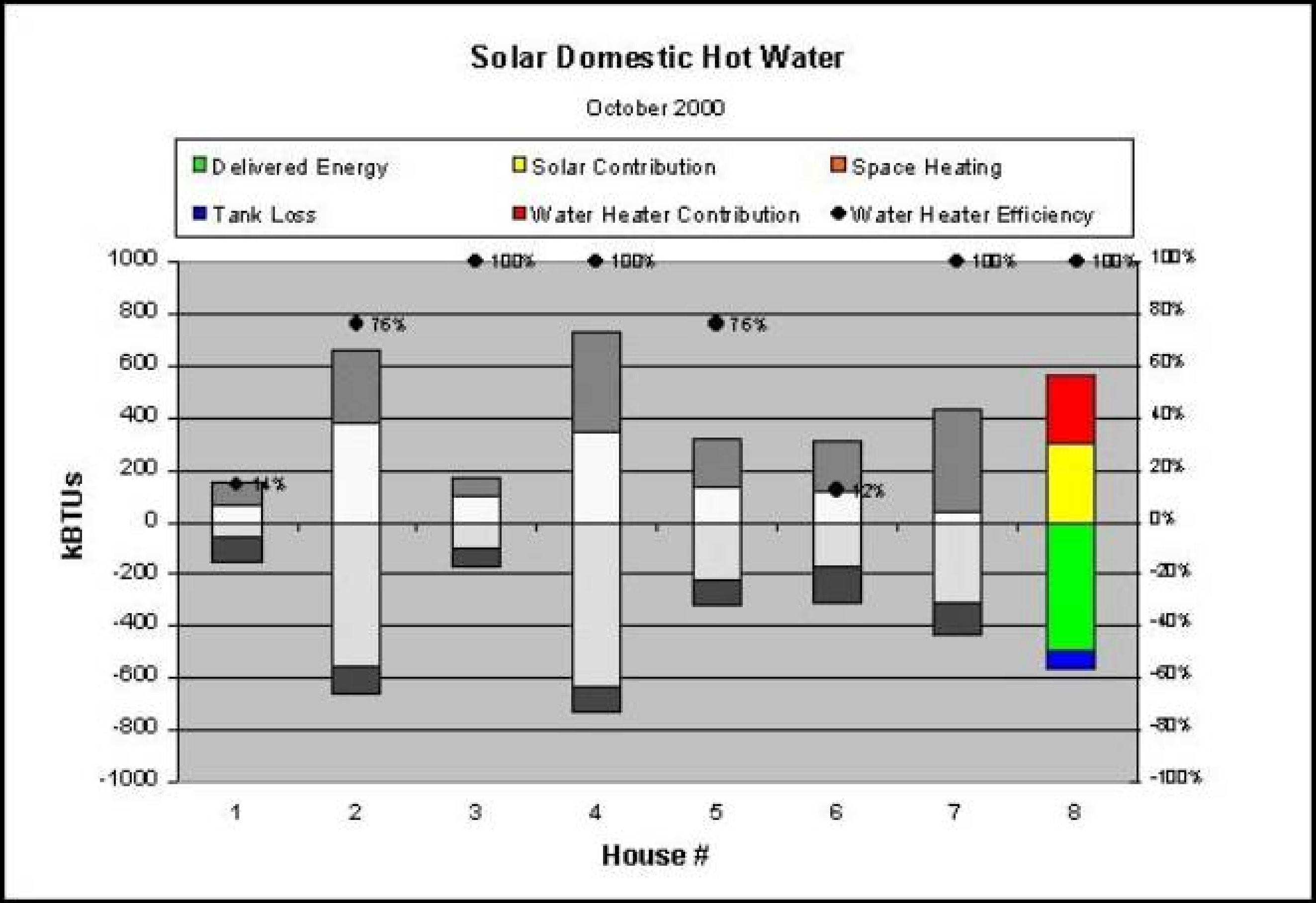


House 7

A.M. Consumption	P.M. Consumption	Observations
High	Low	Night time cooling of the ICS & piping inefficiencies limit SC 10%

Communities

Civano – Solar Contribution



House 8

A.M. Consumption	**P.M. Consumption**	**Observations**
Very High	**Moderate**	**SC is approximately 54%**

Influence of Building America